CLAIMS

1. A radioactive transition metal-imido hetero-diphosphine complex compound of formula (I):

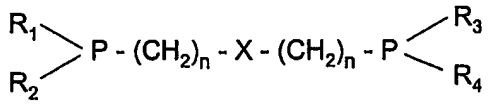
$$[(Me{=}N\text{-}R)L^1L^2]^+Z^- \qquad (I),$$

wherein:

Me is a radioactive transition metal selected from the group consisting of ^{99m}Tc, ^{186}Re, ^{188}Re;

R is a C_1-C_{15} linear or branched alkyl or alkenyl residue, optionally interrupted by -O-, -S-, -N(R')-, where R' = H or C_1-C_6 alkyl, and/or optionally substituted with halogen, hydroxy, C_1-C_5 alkoxy, carboxy, ester, thiol, primary or secondary amino or amido, groups, or R is phenyl or an aryl residue, being R optionally substituted with a biologically active substance, wherein said biologically active substance is selected among sugars, amino acids, fatty acids, vitamins, hormones, peptides, catecholamines, said catecholamines being optionally conjugated, via peptidic bond, to the other above mentioned biologically active substances;

L^1 is a tridentate hetero-diphosphine ligand of formula (II):



(II),

wherein:

R^1, R^2, R^3 and R^4, which may be the same or different, have the same meanings as R;

X is oxygen, sulphur, NR^5, wherein R^5 is hydrogen or R;

n is an integer ranging from 1 to 5;

L^2 is a bidentate ligand, which comprises a combination of two donor atoms, selected from the group consisting of oxygen, sulphur and nitrogen,

said atoms being preferably negatively charged and being separated by a spacer of 2 to 4 members, said spacer being an aliphatic chain or part of an aromatic ring, L^2 being optionally conjugated to a biologically active substance as above defined;

Z^- is a mononegative counter-ion selected from the group consisting of Cl^-, Br^-, OH^-, ClO_4^-, EtO^-, tetrafluoroborate .

2. A radioactive transition metal-imido hetero-diphosphine complex according to claim 1, wherein the radioactive transition metal is ^{99m}Tc.

3. A radioactive transition metal-imido hetero-diphosphine complex according to any of the preceding claims, wherein R is selected from the group consisting of methyl, ethyl, propyl, isopropyl, butyl, isobutyl, octyl, decyl, dodecyl, propenyl, butenyl, pentenyl, phenyl, benzyl, tolyl, 4-methoxy-benzyl, 4-ethoxy-benzyl, salicyl.

4. A radioactive transition metal-imido hetero-diphosphine complex according to claim 3, wherein R is substituted with a biologically active substance, said substance being a catecholamine selected from the group consisting of dopamine, L-DOPA, 3-hydroxythyramine, optionally conjugated, via peptide bond, to another biologically active substance of claim 1.

5. A complex according to claim 4, wherein dopamine is conjugated to vitamin H.

6. A radioactive transition metal-imido hetero-diphosphine complex according to claim 1, wherein L^1 is selected from the group consisting of:

$(C_6H_5)_2PCH_2CH_2N(H)CH_2CH_2P(C_6H_5)_2$;

$(C_6H_5)_2PCH_2CH_2N(CH_3)CH_2CH_2P(C_6H_5)_2$;

$(C_6H_5)_2PCH_2CH_2N(CH_2CH_2OCH_3)CH_2CH_2P(C_6H_5)_2$;

$(CH_3)_2PCH_2CH_2N(CH_3)CH_2CH_2P(CH_3)_2$;

$(C_6H_5)_2PCH_2CH_2SCH_2CH_2P(C_6H_5)_2$;

$(C_6H_5)_2PCH_2CH_2OCH_2CH_2P(C_6H_5)_2$;

7. A radioactive transition metal-imido hetero-diphosphine complex according to claim 1, wherein L^2 comprises a combination of two electron-donor atoms selected from the group consisting of [O^-,O^-], [N^-,O^-], [S^-,O^-], [N^-,N^-], [N^-,S^-] and [S^-,S^-], said atoms being separated by a 2 to 4 membered spacer, wherein said spacer is an aliphatic chain or part of an aromatic ring .

8. A complex according to claim 7, wherein L_2 is selected from the group consisting of catecholate$^{(2-)}$; carbonate$^{(2-)}$; 1,2-phenylenediaminate$^{(2-)}$; 1,2-benzenedithiolate$^{(2-)}$; ethyleneglycolate$^{(2-)}$; ethylenediaminate$^{(2-)}$; ethylenedithiolate$^{(2-)}$; 1,2-aminophenolate$^{(2-)}$; 1,2-aminothiophenolate$^{(2-)}$; thiosalicilate$^{(2-)}$; 1,2-aminoethanolate$^{(2-)}$.

9. A complex according to claim 7, wherein L_2 is conjugated to a catecholamine selected from the group consisting of dopamine, L-DOPA, 3-hydroxythyramine, optionally conjugated to another biologically active substance of claim 1.

10. A complex according to claim 9, wherein dopamine is conjugated to vitamin H.

11. A radioactive transition metal-imido hetero-diphosphine complex according to claim 1, wherein Z^- is Cl^-, ClO_4^-, EtO^-, tetrafluoroborate.

12. A process for the preparation of the radioactive compounds of formula (I) comprising the following steps:

- reacting an oxide of a transition metal MeO_4^- with an excess of tertiary monophosphine, in a hydro-alcoholic solution acidified with hydrochloric acid and in the presence of 1-substituted-2-acetyl hydrazine, to give an imido complex of formula (IV):

$$[(Me{=}N\text{-}R)Y_3(PPh_3)_2] \qquad (IV),$$

wherein:

Me is $^{99m}TcO_4^-$, $^{186}ReO_4^-$, $^{188}ReO_4^-$;

R is as defined in Claim 1;

Y is Cl, Br, OH,

- reacting said compound of formula (IV) with a tridentate hetero-diphosphine ligand L^1, in organic solvents selected from alcohols, chlorinated solvents, acetonitrile or a mixture thereof, optionally in the presence of an organic base, at a temperature ranging from room temperature to the reflux temperature of the solvent, to give the intermediate compound of formula (III):

$$[(Me{=}N\text{-}R)Y_2L^1)]^+Y^- \qquad \text{(III)},$$

wherein:

Me, R, Y, L^1 are as defined above,

- reacting said intermediate compound of formula (III) with a bidentate ligand L^2 in alcoholic solution, after adjusting pH at 7.4 with phosphate buffer.

13. A process according to claim 12,wherein said 1-substituted-2-acetyl hydrazine is 1-phenyl-2-acetyl hydrazine.

14. A process according to claim 12, wherein the oxide of the transition metal is ^{99m}TcO.

15. An intermediate compound of formula (III):

$$[(Me{=}N\text{-}R)Y_2L^1)]^+Y^- \qquad \text{(III)},$$

wherein Me, R, Y, L^1 are as above defined.

16. A radioactive transition metal-imido hetero-diphosphine complex of formula (I) for use in radiodiagnostic imaging.

17. A radioactive transition metal-imido hetero-diphosphine complex of formula (I) for use in radiotherapy.

18. A pharmaceutical composition comprising a radioactive transition metal-imido hetero-diphosphine complex of formula (I) in admixture with pharmaceutically acceptable carriers and/or excipients.